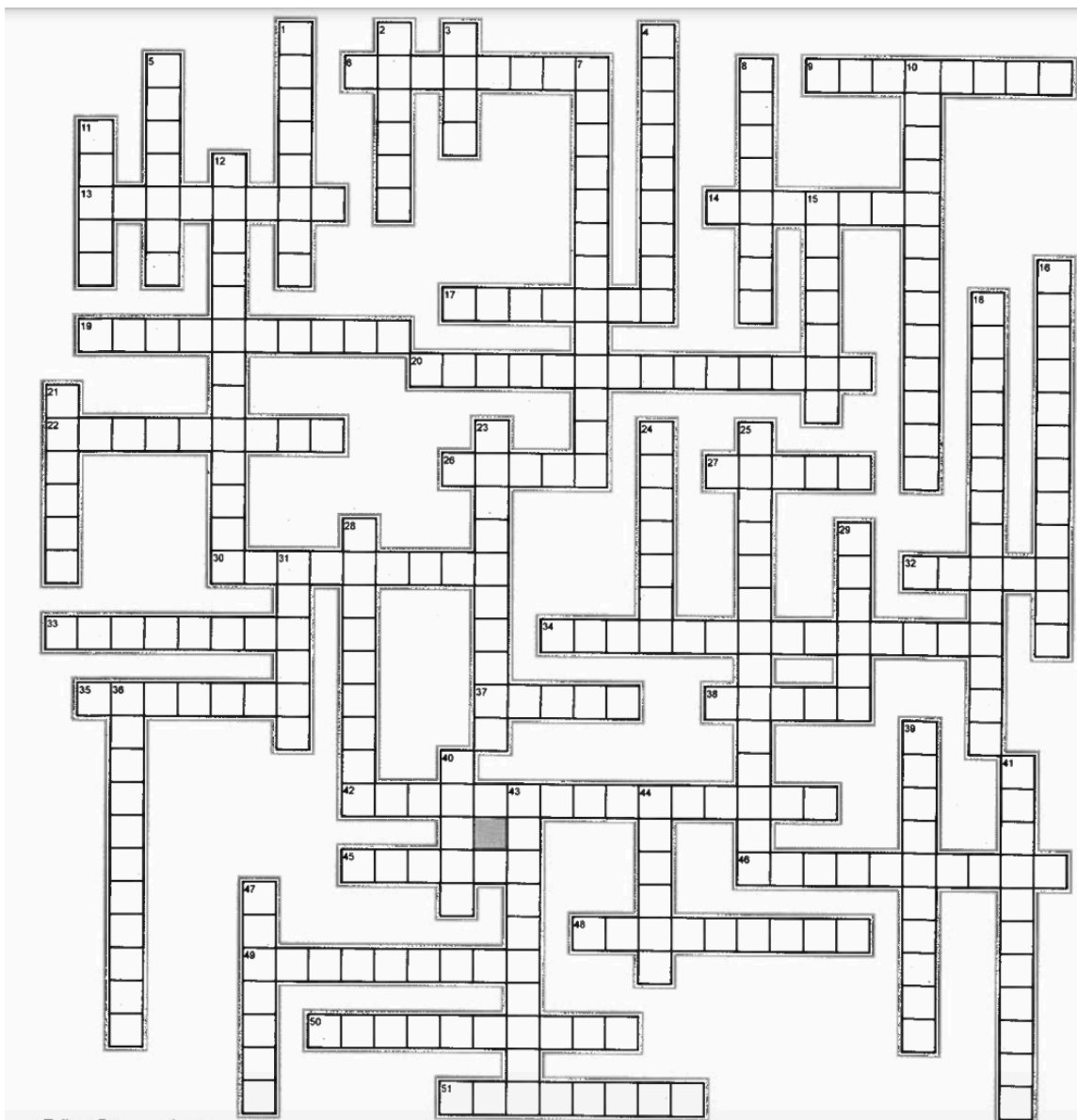


# Nobel Laureate in Chemistry 1961-1970

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## Word bank

APPARATUS ARMSTRONG BROOKLYN CALVIN CANCER CARBON CINCHONA COMBUSTION  
CURIOUS DIFFRACTED EIGEN FEMTOCHEMISTRY GAGARIN GLOBULAR HELIUM HELIX  
HODGKIN HORMONES KING LASER LIBBY MICROWAVE MOLECULAR MOLECULES  
MULLIKEN MUMPS OCEANOGRAPHER PHOTOSYNTHESIS POLYMER POPULATION PORTER  
POYETHLYENE QUANTUM QUININE RADICALS REVERSIBLE RUTHERFORDIUM  
SONOCHEMISTRY SOYUZ SPHEROPROTEINS STEINBECK STIMULATED STYRENE  
SUPERCONDUCTING THERMOPLASTICS THREE TUBERCULOSIS TUTANKHAMUN UNICEF  
WILDERNESS WOODWARD

## Across

6. Professor Ronald Norrish was one of three recipients of the 1967 Nobel Prize in chemistry. He used short pulses of energy (i.e. photons) to alter the equilibrium in chemical reactions. In many experiments the burst of light caused molecules to split into fragments and form \_\_\_\_\_.
9. In 1964, the Verrazano Narrows Bridge in New York City, linked \_\_\_\_\_ and Staten Island and set a standard for span bridges.
13. The 1962 Nobel Prize in Chemistry was awarded to Dr. Max Perutz and Dr. John Kendrew for their work determining the structures of \_\_\_\_\_ proteins.
14. Dr. Dorothy \_\_\_\_\_ developed x-ray techniques and complex calculations to determine the structure of penicillin and vitamin B12.
17. A \_\_\_\_\_ is a string like structure that has a repeating structure.
19. Vitamin B12 is the most complex structure of the vitamins. X-rays (high energy photons) were \_\_\_\_\_ through their structure in order to determine the positions of the atoms.
20. \_\_\_\_\_, Plants transform light (electromagnetic radiation) into chemical energy. In green plants, light converts water, carbon dioxide, and some minerals into O<sub>2</sub> (oxygen) and organic compounds such as sugars (i.e. glucose).
22. Neil \_\_\_\_\_ and Buzz Aldrin were inside the Apollo Lunar Module Eagle when they landed on the moon on July 20, 1969, \_\_\_\_\_'s famous quote when first putting his foot on the moon was "One small step for man, one giant leap for mankind."
26. Dr. \_\_\_\_\_ developed the dating technique that utilized the carbon-14 isotope to measure age of carbon containing objects (aka radiocarbon dating). Dr. Willard \_\_\_\_\_ of UC Berkley.
27. A protein's tertiary structure is its \_\_\_\_\_-dimensional shape.
30. MASER stands for \_\_\_\_\_ amplification by stimulated emission of radiation.
32. The measles vaccine, the \_\_\_\_\_ vaccine and the rubella vaccine were all developed in the 1960's.
33. Robert S. \_\_\_\_\_ won the Nobel "for his fundamental work concerning chemical bonds and the electronic structure of molecules by the molecular orbital method".
34. Globular proteins are spherical structures that are water-soluble and shaped like a sphere. They naturally fold into the shape of a sphere (aka as \_\_\_\_\_).
35. Polystyrene is a synthetic polymer made from monomers (single units) of \_\_\_\_\_.
37. The \_\_\_\_\_ is a brand of spacecraft developed in the USSR (Soviet Union) in the 1960's and made over 120 flights.
38. Dr. Charles Townes was a co-recipient of the 1964 Nobel Prize in Physics. He invented the \_\_\_\_\_.
42. Liquid helium is used to cool \_\_\_\_\_ magnets used in instruments such as NMR (nuclear magnetic resonance).
45. Lev Landau won the 1962 Nobel Prize in physics for his work in condensed matter, specifically for his work with liquid \_\_\_\_\_ (BP = 4.2 Kelvin / -269 °C).
46. Laser stands for Light amplification by \_\_\_\_\_ emission of radiation
48. The 1962 Nobel Prize in Literature was awarded to John \_\_\_\_\_ for his novels, such as the *Grapes of Wrath*, *Cannery Row*, and *Of Mice and Men*. Some of his stories focused on the struggles of the oppressed working class.
49. Scuba stands for Self Contained Underwater Breathing \_\_\_\_\_
50. Dr. Lars Onsager won the 1968 Nobel Prize in chemistry for his work describing reactions that, thermodynamically were not \_\_\_\_\_.
51. Quinine is a natural product that was extracted from the bark of the \_\_\_\_\_ tree. Quinine is a well-known natural product that was used by native populations in South America to kill the parasite that caused malaria. While an effective source for small groups of people, this source could not meet the world's requirement.

## Down

1. Dr. Robert \_\_\_\_\_ was a ground breaking synthetic organic chemist. He developed unique chemical reactions to convert small molecules into larger organic molecules that were of great use to humanity. He was the sole recipient of the chemistry prize in 1965.
2. The 1961 Nobel Prize in Chemistry was awarded to Dr. Melvin \_\_\_\_\_ for tracing the path of carbon through the photosynthesis process (used carbon dioxide).
3. The 1964 Nobel Peace Prize was awarded to Dr. Martin Luther \_\_\_\_\_ Jr. for his peaceful approach to seeking civil rights for African Americans.
4. Dr. Dorothy Hodgkin won the Nobel Prize in Chemistry (1964). Her work was focused on biology at the \_\_\_\_\_ level.
5. The 1965 Nobel Prize in Physics was awarded to Sin-Itiro Tomonaga, Julian Schwinger and Richard P. Feynman developing quantum electrodynamics. Dr. Feynman would later publish a very popular book, read by laymen around the world, called "Surely You're Joking, Mr. Feynman!": Adventures of a \_\_\_\_\_ Character." (hint, its a good read).
7. \_\_\_\_\_ utilizes ultrasound to accelerate or change the type of reaction taking place. It uses ultrasound radiation in the 20 kHz to 20 MHz range.
8. Three common examples of globular proteins are antibodies, enzymes and \_\_\_\_\_.
10. Jacques Cousteau, the French \_\_\_\_\_, was working on 3 underwater villages called Precontinent I, Precontinent II and Precontinent III in the 1960's. They were at different depths for underwater workers.
11. Dr. Manfred \_\_\_\_\_ won the 1967 Nobel Prize in chemistry. He was one of three recipients that year. He used sound waves to stimulate some chemical reactions to go faster. One example was dissolving salts in a specific solvent
12. The element Rf or \_\_\_\_\_ is a man made radioactive element that has chemical and physical properties similar to hafnium and zirconium.
15. Yuri \_\_\_\_\_ (USSR) was the first human in space. He circled the planet at 27,000 km/hour. It lasted less than 2 hours..
16. Mycobacterium tuberculosis is the bacterium responsible for \_\_\_\_\_ (Tb). Up until the early 1960s, Tb patients were treated for up to 24 months, with time spent in the hospital. New antibiotics in the 1960's, many are still in use today, helped reduce the time needed to treat Tb down to 3 to 6 months. Tb is one of the deadliest diseases in the history of humanity, and drug resistant Tb is now a problem. One sneeze from an infected person can infect up to two dozen people in close quarters (i.e. crowded room).
18. \_\_\_\_\_ is the study of ultrafast chemical reactions that can be studied by pulses of light that take place on the order of  $10^{-15}$  seconds (a femto-second).
21. The \_\_\_\_\_-14 isotope has a half-life of 5730 years. As a rule of thumb, it cannot measure the age of an object that is more than 60,000 years old.
23. The 1964 \_\_\_\_\_ Act, the U.S. Congress started a formal process of setting aside wilderness areas for the long term benefit of Americans.
24. The total synthesis of \_\_\_\_\_ was published in 1944 by Dr. Robert Woodward and William Doering. \_\_\_\_\_ was a critical anti-malaria drug needed by the military fighting in the South Pacific (WW2).
25. Polyethylene (PE), Polystyrene (PS), Polypropylene, Polyvinyl chloride (PVC), Polyester, Nylon, Acetals are examples of \_\_\_\_\_.
28. Dr. Mulliken outlined how a Linear Combination of Atomic Orbitals (LCAO) could be used to construct a set of Molecular Orbitals (MO). MO's are the paths that electrons travel in covalent bonds, bonding atoms together to form \_\_\_\_\_.
29. Dr. George \_\_\_\_\_ shared the 1967 Nobel Prize for his studies of extremely fast chemical reactions using very short pulses of light. He worked with Dr. Norrish.
31. Dr. Peyton Rous was awarded the Nobel Prize in Medicine for demonstrating that cancer can be spread from one organism (i.e. chicken) to another by transferring \_\_\_\_\_ cells.
36. "For example, we used seeds and plant material from \_\_\_\_\_'s tomb, which is very precisely dated. We also used seeds from a room underneath the Saqqara step pyramid dated to a specific year of the reign of King Djoser," from: <https://www.bbc.com/news/10345875>

39. \_\_\_\_\_ inversion exists in a laser. It is when there are more electrons in the excited state than in the ground state.
40. The 1962 Nobel Prize in Physiology or Medicine was awarded to Francis Crick, James Watson and Maurice Wilkins for uncovering the Double \_\_\_\_\_ structure of DNA.
41. A simple polymer is \_\_\_\_\_, which is composed of  $-CH_2-$  units,
43. An example of a non-reversible chemical reaction is the \_\_\_\_\_ process in a flame, where air (oxygen, nitrogen) and hydrocarbons react to form a product.
44. The 1965 Nobel Peace Prize was awarded to United Nations Children's Fund : \_\_\_\_\_ for their efforts to bring economic equality for those in poor nations.
47. Helium is unique as a (elemental) liquid. The liquid form that follows the laws of physics is called Helium I; it exists from the BP at 4.2 Kelvin down to 2.18 Kelvin. The second form of liquid Helium 2, exists below 2.18 K, and follows some unique and interesting laws of \_\_\_\_\_ quantum physics. Absolute zero ( 0 K) has never been achieved. [https://www.youtube.com/watch?v=YVMuI\\_shltE](https://www.youtube.com/watch?v=YVMuI_shltE) A classic video (1963) showing the superfluid (He(II)) - which has zero entropy.